

EXHIBIT C

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Soil and Groundwater Investigation Work Plan

**The Camas Property
Tacoma, Washington**

**Prepared for
Camas Associates**

**Prepared by
Floyd Snider McCarthy, Inc.**

ECOLOGY REVIEW DRAFT

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1.0 Introduction

PURPOSE

This work plan was prepared by Floyd Snider McCarthy, Inc. (FSM) in response to a request by Camas Associates, Inc. (Camas) to investigate soil and groundwater conditions at The Camas Property (Site), located at 2926 South M Street in Tacoma, Washington. The investigation has been initiated in response to Washington State Department of Ecology (Ecology) concerns regarding the Site. The investigation at the site is currently being conducted as an independent action. The purpose of this investigation is to provide sufficient information to evaluate the nature, extent, and potential sources of contamination at the Site and to support appropriate further action, in any, according to the Washington State Model Toxics Control Act, Chapter 173-340 WAC (MTCA).

SITE LOCATION

The Site is located at 2926 South M Street in Tacoma, Washington (Figure 1). The property is developed with a one-story, 60,508 square foot building (the Row-Tac Building), which is currently leased to Northwest Textiles, a rag distributor. From 1917 to 1950, prior to the construction of the Row-Tac Building in circa 1951, the property was used as a junkyard and for manufacturing roofing materials (Saltbush 1994). Sanborn Fire Insurance maps and an aerial photograph from 1946 indicate that site features included a junkyard, stills, tanks, boilers, and tar barrels. Facilities located on adjacent properties have included bulk fuel distributors, truck repairs, a gas station, a chlorine manufacturer, and fuel storage facilities.

Site observations and previous testing indicated the presence of contaminated shallow soil and groundwater beneath the Site (Saltbush 1994, 2002). Specifically:

- There are areas in the parking lot where a tarry substance has seeped up through cracks in the pavement, possibly indicating releases of tar, crude oil, pavement patching, and other substances associated with previous Site activities.
- Soil used to construct a ramp located in the southwestern portion of the Site is stained with an oily substance. This indicates past practices may have caused subsurface soil to become contaminated.
- Samples of soil and groundwater from the southwestern portion of the property contained diesel-range petroleum hydrocarbons (TPH-D), oil-range hydrocarbons (TPH-O), benzene (B), toluene (T), ethylbenzene (E), xylenes (X) and a number of PAHs (Boring B-1). This may represent contamination associated with the adjacent former fuel storage facility or from crude oil storage tanks at the former roofing tar facility.
- Samples of soil and groundwater collected from the southeastern portion of the property contained TPH-D, TPH-O, PAHs and PCBs (Boring B-2). This may represent contamination associated with the former adjacent fuel storage facility and/or handling and refining activities associated with manufacturing roofing tar.

- Samples of soil and groundwater collected from areas adjacent to the east property line contained TPH-D, TPH-O and metals (Boring B-3). This may represent contamination associated with the former adjacent fuel storage facility, the junkyard, or the former roofing tar manufacturer.

The soil samples collected during the 2002 investigation (Saltbush 2002) contained TPH (diesel), BTEX, metals, volatile organic compounds (VOCs) and semivolatile organics compounds (SVOCs) at concentrations exceeding MTCA Method A cleanup levels. The groundwater samples tested exceeded MTCA Method A cleanup levels for TPH (diesel and heavy oil), BTEX, metals, SVOCs, and PCBs. These results, based on limited testing, suggest the following preliminary contaminants of concern (PCOCs) for this site:

- For soil: TPH-diesel, BTEX; volatiles (trichloroethene (TCE) only); semivolatiles (naphthalene only).
- For groundwater: TPH-diesel and heavy oil, BTE, semivolatiles (naphthalene only) and PCBs.

The goal of this investigation is to evaluate the nature and extent of the tarry substance observed in the parking lot, and contamination, if any, associated with the former roofing tar, junkyard facility, and former fuel storage facility. Following the subsurface investigation, a Site Characterization Report will be prepared that will describe and document the location of potential contamination, the potential source area (or areas) for contamination, and potential receptors and significance. The report will provide sufficient geology and hydrogeology information so that remedial alternatives may be developed, if necessary.

This work will be accomplished in phases. Phase I will consist of a shallow subsurface investigation in which soil and perched groundwater, if encountered, will be sampled and analyzed. Phase II work would be initiated if results from Phase I indicate that contamination has migrated to depths greater than approximately 7 to 15 feet. Phase II work would include collecting and analyzing deeper soil and groundwater samples from the water table aquifer. Samples collected during Phase I will be sent to a laboratory and analyzed for chemicals appropriate to the type of contamination that is encountered. Results will be incorporated into the Site Characterization Report, consistent with the provisions of MTCA.

SITE DESCRIPTION

The Site is situated at approximately 250 to 260 feet above sea level (Saltbush 2002). The topographic surface slopes gently to the south. The soils in the area have been classified as Alderwood gravelly sandy loam. The near-surface groundwater is assumed to flow southeast, in the direction of the topographic gradient. Groundwater was encountered at 27 to 28 feet below ground surface (bgs).

The Row-Tac building covers much of the Site. The Phase I investigation will be conducted on accessible locations outside of this building.

2.0 Phase I - Shallow Subsurface Investigation

PRELIMINARY SITE RECONNAISSANCE

Prior to the subsurface investigation, FSM will perform a preliminary Site reconnaissance to accomplish the following:

- A scaled Site map will be made. Currently available maps are not to scale. A basic map will be prepared using the dimensions of the existing Row-Tac building and measuring the distances from this building to features of interest, including former borings, existing wells, and property lines. Property line locations can likely be estimated by the locations of fence lines, pavement changes, changes in land use and other visual indicators. The scaled Site map will be sufficiently accurate to document the locations of the planned explorations.
- Underground utilities will be marked in the vicinity of proposed subsurface exploration locations with the help of a utility locate contractor. In addition, access problems or potential hazard conditions will be evaluated.
- Proposed subsurface explorations will be marked with paint at locations that appear to be clear of subsurface utilities and in places useful for delineating the extent of shallow soil contamination.

FSM understands that Ecology plans to evaluate the condition of an existing groundwater monitoring well, located near the southeast corner of the Row-Tac building. If the well is determined by Ecology to be in good condition, Ecology will conduct sampling in this well. If appropriately screened, data obtained from this well will be incorporated into the evaluation of Site conditions.

SHALLOW SUBSURFACE INVESTIGATION

The purpose of the shallow subsurface investigation is to delineate the nature and extent of any shallow soil contamination encountered in the first 7 to 15 feet bgs. Perched groundwater, if encountered, will be sampled at a maximum of two locations. Based on the results of four previous borings at the Site, perched water may be encountered in the vicinity of B-1 (Figure 3).

Soil samples will be collected with a geoprobe sampling device in at least 15 locations within Site boundaries. Figure 2 shows the approximate boring locations. Under ideal conditions, the geoprobe device can take continuous soil cores about 4 feet in length. The soil core will be enclosed in a clean, disposable plastic tube, which will minimize the potential for cross-contamination. The soil will be removed by cutting the tube open with a knife.

Soil will be field-screened using a photo-ionization detector (PID). A licensed geologist will describe the soils on a boring log form, noting any indications of contamination and groundwater occurrence. Up to three samples from each probe location will be placed in laboratory sample jars. Representative samples of the contaminants will be collected to evaluate their vertical extent in the soil. One of these will be a sample of soil collected from bottom of the boring.

Soil samples will be transferred to laboratory jars with a clean metal spoon or similar device. Samples to be tested for volatile compounds will be placed directly into laboratory-supplied jars. The remaining soil will be homogenized in a stainless steel bowl and placed in a laboratory jar. The samples will be stored on ice in a cooler and transported under chain-of-custody to the laboratory.

If tarry, the soil will be homogenized in disposable aluminum pie plates before being placed into jars. The spoon and bowl will be washed with soapy water and rinsed with distilled water after each sample is prepared. If tarry residues are present, the item will be decontaminated with hexane and wiped dry with paper towels. It will then be washed again with soapy water and rinsed with distilled water.

Perched groundwater, if encountered, will be sampled using a peristaltic pump and disposable tubing. The tubing will be guided into the temporary well point through the hollow geoprobe drill rods. Groundwater samples will be collected after sufficient purging to reduce turbidity. The water will be pumped into laboratory-supplied bottles. The samples will be stored on ice in a cooler and transported to the laboratory using appropriate chain-of-custody protocols.

After the samples are collected, the boreholes will be filled with bentonite chips and the pavement will be patched. The drilling equipment and temporary well points will be cleaned using a hot water pressure washer. If tarry, the equipment that directly contacts the sample will be cleaned using hexane, and wiped dry with paper towels. It will then be washed again with soapy water and rinsed with distilled water. Because the soil coring device is lined with a disposable plastic tube, significant cross-contamination is unlikely.

Potentially contaminated soil cuttings, hexane- and tar-contaminated disposable supplies will be stored in drums until disposal is arranged by FSM. These drums will be stored on the Site at a location of the property owner's choosing. Residuals will be disposed of after the fieldwork is completed.

LABORATORY TESTING

Samples will be delivered to a laboratory and analyzed as shown on Table 1.

Table 1 Summary of Phase I Testing			
Matrix	Estimated Quantity	Analysis	Comments
Soil	Up to 30	NWTPH-HCID; TPH-Gasoline/BTEX (NWTPH-Gx/EPA Method 8021); TPH-Diesel and oil (NWTPH-Dx);	Test at least one sample from each location. Select further tests based on HCID results. Test one blind duplicate for HCID. Do not exceed a total of 30 analyses.
Soil	5	PCBs (Method 8082)	Select most tarry samples
Soil	54	SVOCs (Method 8270)	Select most tarry samples.
Soil	5	VOCs (Method 8260)	Select samples with elevated PID results.
Soil	7	RCRA metals – As, Ba, Cd, Cr, Pb, Se, Ag, Hg (Methods 200.7/6010, 245/7470/7471)	Select based on field observations.
Product	1	Fingerprint (GC-FID)	To identify product(s), if present.
Water	1	NWTPH-HCID; TPH-Gasoline/BTEX (NWTPH-Gx/EPA Method 8021); TPH-Diesel and oil (NWTPH-Dx);	Select further tests based on HCID results.
Water	1	SVOCs (Method 8270)	
Water	1	VOCs (Method 8260)	
Water	1	RCRA metals – As, Ba, Cd, Cr, Pb, Se, Ag, Hg (Methods 200.7/6010, 245/7470/7471)	

DATA EVALUATION

In addition to existing data, the field and laboratory data obtained during Phase I will be used to evaluate the nature and extent of contamination in the shallow soil. If contamination is of limited vertical extent, FSM will request that Ecology issue a No Further Action (NFA) letter for this Site.

3.0 Phase II - Install Monitoring Wells and Collect Samples

If the results of the evaluation of data collected during Phase I indicate a potential for soil or groundwater contamination from a Site source, a Phase II groundwater investigation will be implemented. Potential locations for six wells that would be installed for Phase II are shown on Figure 3. The potential well locations have been selected to allow evaluation of groundwater flow directions and gradients, to characterize any groundwater contamination, and to identify potential sources.

DRILLING AND SOIL SAMPLING

Monitoring wells will be constructed using hollow stem auger (HSA) drilling methods. In places with heavy, tarry soil contamination, a temporary conductor casing may be employed. This will prevent carry-down of contaminated soil into the aquifer. The temporary conductor casing will consist of an HSA with an inside diameter large enough (about 10 inches) to accommodate a standard 4-inch inside diameter HSA. The temporary conductor casing will be advanced until it is below the heavily contaminated soil. Then, the smaller diameter HSA will be inserted inside the HSA and the boring will be advanced downward to the water table, which is about 27 to 28 feet bgs.

Driven spilt-spoon soil samples will be collected at approximately 2.5-foot intervals, starting at depths between 2.5 feet and extending to a maximum of approximately 15 feet bgs. Soil samples will be field-screened using a PID, and described on a boring log form, noting contamination and groundwater occurrence. Soil samples will be placed in laboratory jars using the methods described previously. The samples will be stored on ice in a cooler and transported under chain-of-custody to the laboratory. Sampling and drilling equipment will be cleaned using the same methods employed in Phase I.

Monitoring wells will be constructed with 2-inch in diameter, schedule 40 PVC casing, and 20-slot by 5- to 10-foot long well screen that is surrounded with a 10-20 sand filter pack. Based on previous work (by Saltbush), the wells will reach a depth of approximately 30 to 35 feet. The well screen will be placed across the water table to detect free product, if present. Flush-mount protective monuments will be used so as to avoid creating obstructions in the parking lots.

Soil cuttings and contaminated materials will be stored in labeled, 55-gallon open-top drums. Drums will be stored on the Site at a location of the property owner's choosing. After fieldwork is complete and reports are prepared, FSM will arrange for appropriate off-site soil disposal after the fieldwork is completed.

WELL DEVELOPMENT, ELEVATION MEASUREMENT AND GROUNDWATER SAMPLING

The monitoring wells will be developed by surging and pumping water until the groundwater is clear. Purged water will be placed in drums and stored on the Site. FSM will arrange for disposal after fieldwork is completed.

The elevations of the tops of each of the monitoring well casing will be measured to the nearest 0.01-foot to an assumed datum. These elevations and the depths to the water table will be used to determine the relative elevations of the groundwater surface. One round of water level measurements will be made to evaluate groundwater gradients.

Groundwater samples will be collected from wells that do not contain free product. The groundwater samples will be collected using an electric submersible groundwater purging and sampling pump. First the water level will be measured. Then the sampling pump will be carefully and slowly lowered so its intake is positioned near the center of the well screen. The well will be slowly (less than 0.25 gpm) purged until field parameters (pH, conductivity, dissolved oxygen, and turbidity) become stable over three consecutive measurements each taken about 2 minutes apart. Stabilization means the readings are within 10 percent of each other. The well will then be sampled. A minimum of 0.5 casing volume of water will be purged prior to sampling. If field parameters do not stabilize, the sample will be collected after three casing volumes of water have been purged.

If these criteria cannot be achieved before the well runs dry, the well will be allowed to recover to within 90 percent of the original casing volume and then the groundwater sample will be collected.

The samples will be stored on ice in a cooler and transported under chain-of-custody to the laboratory.

All reusable sampling equipment will be washed with a solution of soapy water before each use, and rinsed with tap water. Disposable sampling materials, such as the discharge tubing, will be discarded after each use.

Any wells containing free product will be sampled by first measuring water levels with an interface probe. The product sample will then be collected using a disposable bailer. The bailer will be discarded after use.

LABORATORY TESTING

Soil, groundwater, and product samples will be delivered to a laboratory and analyzed as follows:

Table 2
Summary of Phase II Testing

Matrix	Estimated Quantity	Analysis	Comments
Soil	12	TPH Gasoline (NWTPH-GX); TPH-Diesel and oil (NWTPH-DX)	Test two samples per boring; one from smear zone and one additional sample; use previous Phase I results to select method. Determine need for duplicate samples.
Water	6	SVOCs (Method 8270)	One sample per well. Determine need for duplicate sample.
Water	6	VOCs (Method 8260)	One sample per well. Determine need for duplicate sample.
Water	7	RCRA metals: As, Ba, Cd, Cr, Pb, Se, Ag, Hg, (Methods 200.7/6010, 245/7470/7471).	One sample per well. Determine need for duplicate sample.

SITE CHARACTERIZATION REPORT

The accumulated data from the geoprobes, the existing monitoring well, and any newly installed wells will be used to evaluate the nature and extent of soil and groundwater contamination, if any, and develop a Site Characterization Report. This report will be used to support either a request for NFA or as a basis for developing plans for additional investigation and/or cleanup alternatives, as appropriate. FSM anticipates that contaminants of concern (COCs), proposed clean up levels (CULs), and proposed points of compliance (POCs) will be identified.

The Site Characterization Report will include the following elements.

- Description of the work performed, with references to this Work Plan regarding details where possible
- Tables of analytical results
- A map, to scale, of actual sampling locations and well numbers
- Laboratory reports and chain-of-custody reports
- Boring and well construction logs
- Well casing reference elevations including datum used

4.0 Quality Assurance Project Plan

This Quality Assurance Project Plan (QAPP) establishes quality control (QC) procedures and quality assurance (QA) criteria to meet the data quality objectives (DQOs) set forth for the Site investigation sampling to be conducted at the Camas Property. This QAPP was developed in accordance with the Washington Department of Ecology Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (Ecology 2001b).

DATA QUALITY OBJECTIVES

The DQOs for sampling are to obtain the types and quantity of data in a manner such that the data are of known, appropriate, and sufficient quality to support the intended use, which is to identify potential source areas and delineate the nature and extent of contaminated soil and groundwater, if any, at the site. Field DQOs for individual samples are listed in Table 3.

Table 3 Field Data Quality Objectives	
Objective	Method(s)
Accurately document sample locations	Prepare scale site map using tape measure Measure relative elevations of well casings Document sample identifications and locations
Properly decontaminate sampling equipment	Follow documented decon procedure
Create proper soil descriptions	Use USCS classification system
Document conditions during sample collection	Actively record field conditions and events

Analytical DQOs, such as reporting limits, are listed in Table 4. Analytical DQOs also include obtaining data that are technically sound and properly documented, having been evaluated against established criteria for the principle data quality indicators (DQIs) (i.e., precision, accuracy, representativeness, completeness, and comparability [PARCC]) as defined in Ecology (Ecology 2001b) and guidance set forth by the U.S. Environmental Protection Agency (USEPA 1998).

Table 4 Reporting Limits, Holding Times and Sample Volumes					
Matrix	Analytes	Reporting Limit	Preservative	Hold Times	Container(s)
NW TPH-HCID					
Water		0.25 - 0.5 mg/lk	None	7 days	(2)-500ml
Soil		25 - 100 g/kg	None	14 days	8 oz

Table 4
Reporting Limits, Holding Times and Sample Volumes

Matrix	Analytes	Reporting Limit	Preservative	Hold Times	Container(s)
NW TPH-G					
Water		0.25 mg/l	HCl	14 days	(2) 40 ml
Soil		5 mg/kg	None	14 days	2 oz
NW TPH-TPH-D					
Water		0.25 mg/l	None	7 days	(2) 500 ml
Soil		5 mg/kg	None	14 days	8 oz
NW TPH-Dx					
Water		0.5 mg/l	None	7 days	(2) 500 ml
Soil		10 mg/kg	None	14 days	8 oz
Method 8021 B (BTEX)					
Water	Benzene	1.0 µg/l	HCl	14 days	(2) 40 ml
Soil	Benzene	20 µg/kg		14 days	2 oz
Water	Ethylbenzene	1.0 µg/l	HCl	14 days	2 oz
Soil	Ethylbenzene	25 µg /kg		14 days	2 oz
Water	Toluene	1.0 µg/l	HCl	14 days	2 oz
Soil	Toluene	25µg/kg		14 days	2 oz
Water	Xylenes	1.0 µg/l	HCl	14 days	2 oz
Soil	m/p+o xylenes	25+ 50 µg/kg		14 days	2 oz
Method 8082 (PCB)					
Soil	Individual Aroclors	33 µg/kg	None	14 days	8 oz
Method 8270 (SVOA)					
Water	Compounds vary	1-10 µg/l		7 days	(2) 500 ml
Soil	Compounds vary	67-670 µg/kg		14days	8 oz
Method 8260 B (VOA)					
Water	Compounds vary	1-5 µg/l*	HCl	14 days	(3) 40 ml
Soil	Compounds vary	1-5 µg/kg*	None	14 days	2 oz
Method 6010 B (Metals by ICP)					
Water	Arsenic	0.05 mg/l	HNO ₃	6 mos	500 ml
Soil	Arsenic	5 mg/kg	none	6 mos	4 oz

Table 4
Reporting Limits, Holding Times and Sample Volumes

Matrix	Analytes	Reporting Limit	Preservative	Hold Times	Container(s)
Water	Barium	0.003 mg/l	HNO ₃	6 mos	500 ml
Soil	Barium	0.3 mg/kg	none	6 mos	4 oz
Water	Cadmium	0.002 mg/l	HNO ₃	6 mos	500 ml
Soil	Cadmium	0.2 mg/kg	none	6 mos	4 oz
Water	Cromium	0.005 mg/l	HNO ₃	6 mos	500 ml
Soil	Cromium	0.5 mg/kg	none	6 mos	4 oz
Water	Lead	0.02 mg/l	HNO ₃	6 mos	500 ml
Soil	Lead	2.0 mg/kg	none	6 mos	4 oz
Water	Selenium	0.05 mg/l	HNO ₃	6 mos	500 ml
Soil	Selenium	5.0 mg/kg	none	6 mos	4 oz
Water	Silver	0.3 mg/l	HNO ₃	6 mos	500 ml
Soil	Silver	0.003 mg/kg	none	6 mos	4 oz
Method 7470 A (Mercury)					
Water		0.01 µg/l	HNO ₃	28 days	500 ml
Soil		0.05 mg/kg	none	28 days	4 oz

Notes: *except acrolein which is 50 µg/l

The following information will be provided by the analytical laboratory to ensure that the analytical DQOs are accomplished:

- Method blank analyses will be reported for each sample and the concentration of all compounds of interest identified in those blanks.
- Surrogate spike recovery data will be reported including the name and concentration of all compounds added, percent recoveries, and range of recoveries.
- Matrix spike recovery data will be reported including name and concentration of all compounds added, percent recoveries, and range of recoveries.
- Matrix duplicate analyses will be reported.
- Relative retention times for each analyte detected in the samples.
- Internal laboratory data, including sample storage, extraction, and preparation logs.
- Instrument calibration logs.
- Quantitative reports for all analyses performed.

QUALITY CONTROL PROCEDURES

This section describes the procedures that will be implemented to:

1. Ensure sample integrity from the time of sample collection to the time of analysis in the laboratory.
2. Obtain the appropriate chemical data.
3. Collect field and laboratory QC samples.
4. Monitor performance of the laboratory and field measurement systems.
5. Correct any deviations from the methods or QA requirements established in this QAPP.
6. Report and validate the data.

Sample Collection

Sample locations and sample collection methods for the investigation are identified in detail in Sections 2 and 3 of this Work Plan. Sampling procedures and protocols described are based on proven and acceptable sampling methods. This section describes the procedures for sample collection required to meet the DQOs.

Soil and groundwater samples will be submitted to a laboratory for analyses. (The specific laboratory to perform the analyses will be identified at a later date.) The scope of analytical tests and the associated test methods, including the reporting limit, holding times, and sample volumes for each test method.

Sample Documentation

Sampling activities will be documented in the field on appropriate forms and/or in field notes at the time of sampling. Sample container labels will be completed as described previously in and affixed to each sample container. Each sample container will be labeled and recorded on a Chain-of-Custody Record as described below.

Equipment Decontamination

Sampling equipment will be properly decontaminated prior to collection of each sample to avoid cross-contamination between samples. Decontaminated sampling equipment will be handled in a manner that minimizes contact with potentially contaminated surfaces. Specific procedures for sampling equipment decontamination are presented in the Work Plan.

Field Equipment Calibration and Preventative Maintenance

Field instruments will be properly operated, calibrated, and maintained by qualified personnel according to the manufacturer's guidelines and recommendations. Documentation of routine and special preventive maintenance and calibration information will be maintained in field notes.

Each maintenance and calibration entry will include the date and name of the individual performing the activity.

Sample Handling

This section describes the procedures for sample handling following sample collection.

Sample Preservation and Storage

Samples submitted to the analytical laboratories will be collected in the appropriate sample containers and preserved according to method specifications. Storage temperatures, and maximum holding times for soil and groundwater samples are presented in Table 4.

Sample Custody

The primary objective of sample custody is to create an accurate, written record that can be used to trace the possession and handling of samples so that their quality and integrity can be maintained from collection until completion of all required analyses. Adequate sample custody will be achieved by means of approved field and analytical documentation. Such documentation includes the Chain-of-Custody Record, which is initially completed by the sampler, and is thereafter signed by those individuals who accept custody of the sample. A sample will be considered to be in custody if it is:

- In someone's physical possession
- In someone's view
- Locked up or secured in a locked container or otherwise sealed so that any tampering would be evident
- Kept in a secured area, restricted to authorized personnel only

Sample control and chain-of-custody in the field and during transport to the laboratory will be conducted in general conformance with the procedures described in the following sections.

Field Custody Procedures

The following field custody procedures will be followed:

- Persons handling samples will be kept to a minimum.
- The sample collector will be personally responsible for the completion of the Chain-of-Custody Record and the care and custody of collected samples until they are transferred to another person, or dispatched properly under chain-of-custody rules.
- The site Field Geologist/Engineer will oversee implementation of the field custody procedures and in the event of noncompliance will determine if corrective action is required.

Sample Shipment Custody Procedures

The following sample shipment custody procedures will be followed:

- The coolers will be shipped or hand-delivered. The coolers will be accompanied by the Chain-of-Custody Record. If shipped, the original Chain-of-Custody Record and laboratory copy will accompany the shipment (sealed inside the shipping container).
- The sample collector will sign the Chain-of-Custody Record in the first signature space. When samples are transferred, the individuals relinquishing and receiving the samples will sign the Chain-of-Custody Record and document the date and time of transfer. Each person taking custody will observe whether the shipping container is correctly sealed and in the same condition as noted by the previous custodian.

Laboratory Custody Procedures

A designated sample custodian at the laboratory will accept custody of the shipped samples and certify that the sample identification numbers match those on the Chain-of-Custody Record. If containers arrive broken or mislabeled, the laboratory will note the condition of the containers on the Chain-of-Custody Record and will immediately notify the FSM project manager. The laboratory will maintain sample security and custody as appropriate and as outlined in the laboratory's QAPP.

Sample Packaging and Shipping

The transportation and handling of samples by commercial vendors will be accomplished in a manner that not only protects the integrity of the samples, but also prevents any detrimental effects due to the possible hazardous nature of samples. Regulations for packaging, marking, labeling, and shipping hazardous materials are promulgated by the US Department of Transportation in the Code of Federal Regulations (CFR), 49 CFR 173.6 and 173.24 (USDOT 2002a, 2002b).

Prior to shipping, samples will be placed on sealed, reusable ice packs or double-bagged ice in coolers following collection. A picnic cooler will be used as a shipping container. In preparation for shipping samples, the drain plug will be taped shut, and a large plastic bag will be used as a liner for the cooler. When appropriate, approximately 1 inch of packing material will be placed in the bottom of the liner.

The sample bottles will be placed in the cooler containing ice or frozen gel packs. Samples will be packaged carefully to avoid breakage or cross-contamination using sufficient packing material and will be shipped to the off-site analytical laboratory at the proper temperature (4°C). The Chain-of-Custody Record accompanying the samples to the laboratory will be placed inside a separate plastic bag and taped inside the cooler lid.

The cooler will be taped shut with strapping tape. Custody seals will be placed on the cooler. Samples will be transported to the laboratory within 24-48 hours of collection. The cooler will either be shipped to the laboratory by an overnight carrier or hand-delivered by the field personnel.

Sample Analysis and Testing

Soil and groundwater samples selected for chemical analysis will be analyzed for constituents as listed on Tables 1 and 2. Analytical methods are presented in Tables 1 and 2. Standard Ecology and USEPA sample preparation, cleanup, and analytical methods will be used for all chemical analyses. The analytical laboratory will be certified by Ecology to perform the planned testing. The laboratory internal QAPP and standard operating procedures (SOPs) will provide data quality procedures at a level sufficient to meet the analytical DQOs.

Field Quality Control Samples

Field QC samples will be collected to evaluate data precision and representativeness. Collection of field QC samples will allow identification of potential problems resulting from sample collection and/or sample processing in the field. A summary of the field QC samples and the frequency at which they will be collected and/or analyzed is described in the following subsections.

Blind Field Duplicate

A blind field duplicate will be collected at a frequency of at least one per 20 samples per sample media, excluding QC samples. Duplicates will be collected during Phase I only for TPH testing of soil samples. The extent of duplicate testing during Phase II will be determined after completing Phase I. The blind field duplicate sample will consist of a split sample collected at a single sample location. Split samples will be submitted blind to the laboratory as discrete samples with fictitious sample IDs. These blind field duplicate sample results will be used to evaluate data precision.

The selection criteria for Phase II duplicate testing will be based on the potential presence of an analyte in a medium (soil or groundwater) based on a review of the previous test results. Duplicate samples will not be collected for analytes that were not detected or not detected in potentially significant concentrations.

Field Equipment Rinsate Blank

A field equipment rinsate blank will be collected at a frequency of one per 20 samples of groundwater (or minimum of one per day) to evaluate the effectiveness of groundwater sampling equipment decontamination procedures and the potential for equipment cross-contamination. Equipment rinsate blanks will only be collected for the Phase II groundwater sampling event. Field equipment rinsate blanks will be analyzed for selected COCs. These will be selected prior to beginning Phase II.

Rinsate blanks will consist of deionized distilled water passed over and/or through decontaminated sampling equipment. The equipment surface exposed during sampling collection will be rinsed with the deionized water, which will be collected in the appropriate sample containers. Field equipment rinsate blanks will not be collected when using dedicated or disposable field equipment.

Laboratory Quality Control Samples

Analytical laboratory QC samples will be collected to evaluate data precision, accuracy, representativeness, completeness, and comparability of the analytical results for this investigation. Lab QC samples will be of the type and frequency specified in the governing Ecology and USEPA analytical procedures.

Data Validation and Reporting

Analytical reports from the laboratory for this project will be accompanied by sufficient backup data and QC results to enable reviewers to determine the quality of the data. FSM will review the laboratory reports for internal consistency, transmittal errors, laboratory protocols, and for adherence to the QC elements specified in this QAPP at a "Level 1" (basic) review. The Level 1 Data Validation will include the following:

- Reviewing the sample holding times.
- Verifying sample numbers and analyses match those requested on the chain-of-custody record.
- Verifying the required reporting limits have been achieved.
- Verifying the field duplicates, matrix spikes/matrix spike duplicates, and lab control samples were analyzed at the proper frequency.
- Verifying the surrogate compound analyses have been performed and meet QC criteria.
- Verifying the lab blanks are free of contaminants.

Data that appear to have significant deficiencies will be validated using the more comprehensive Level 2 verification and review in accordance with the USEPA functional guidelines for data validation (USEPA 1999). Following this review, data qualifiers assigned by the laboratory may be amended, as necessary.

QUALITY ASSURANCE CRITERIA

This section describes the data quality indicators (DQIs) and the associated QA criteria that will be used to ensure the data meet the DQOs. DQIs are quantitative statistics and qualitative descriptors used in interpreting the degree of acceptability or utility of the data (USEPA 1998). The principal DQIs include the PARCC parameters (i.e., precision, accuracy, representativeness, comparability, and completeness). Secondary DQIs include quantitation limits, sensitivity, repeatability, reproducibility, recovery, and memory effects. Acceptance criteria for the DQIs and the quantitation limits have been established to set quantitative goals for the quality of data generated in the analytical measurement process.

PARCC Parameters/Limits

The statistical tests and target control limits (the range within which project data of acceptability should fall) for the PARCC parameters are described below. The target control limits will be used to evaluate data acceptability and are considered to be QC goals for data acceptance.

Precision

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed conditions. Precision is best expressed in terms of the standard deviation or relative percent difference (RPD). QA/QC sample types that test precision include field and laboratory duplicates and matrix or blank spike duplicates.

The estimate of precision of duplicate measurements will be expressed as an RPD value, which is calculated:

$$RPD = \left| \frac{D_1 - D_2}{(D_1 + D_2) \div 2} \right| \times 100$$

where: D_1 = first sample value

D_2 = second sample value (duplicate)

The RPD values for duplicates will be calculated and compared with the laboratory's internal control limits. If control limits are exceeded, the analytical laboratory will perform the required re-extraction/reanalysis. If duplicate sample values are within five times the quantitation limit, then the control limit interval will be plus or minus two times the quantitation limit.

Accuracy

Accuracy is the degree of agreement of a measurement (or an average of measurements of the same property) X , with an accepted reference or true value T , usually expressed as the difference between the two values $(X-T)$, the difference as a percentage of the reference or true value $(100 (X-T)/T)$, or as a ratio (X/T) . Accuracy is a measure of the bias in a system and is expressed as the percent recovery of spiked (matrix, surrogate spike, or laboratory control spike) samples:

$$\text{Percent Recovery} = \frac{(\text{Spiked Sample Results} - \text{Unspiked Sample Results})}{\text{Amount of Spike Added}} \times 100$$

The target control limits for percent recovery values are specified in the governing Ecology and USEPA analytical methodologies. The percent recovery value will be calculated by the laboratory and checked against the laboratory internal or method-specific control limits. If control limits are exceeded, the analytical laboratory will perform the required re-extraction/reanalysis.

Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an actual condition or characteristic of a population. Representativeness can be evaluated using replicate samples, representative sampling locations, and blanks. Representativeness for the sampling will be accomplished using appropriate selection of sampling location and analyzing method blanks to verify that the analytical results have not been influenced by cross-contamination.

Completeness

Completeness is a measure of the proportion of data obtained from a sampling event that is determined to be valid. It is calculated as the number of valid data points divided by the total number of data points requested. The QA objective for completeness during this project will be 95 percent.

Comparability

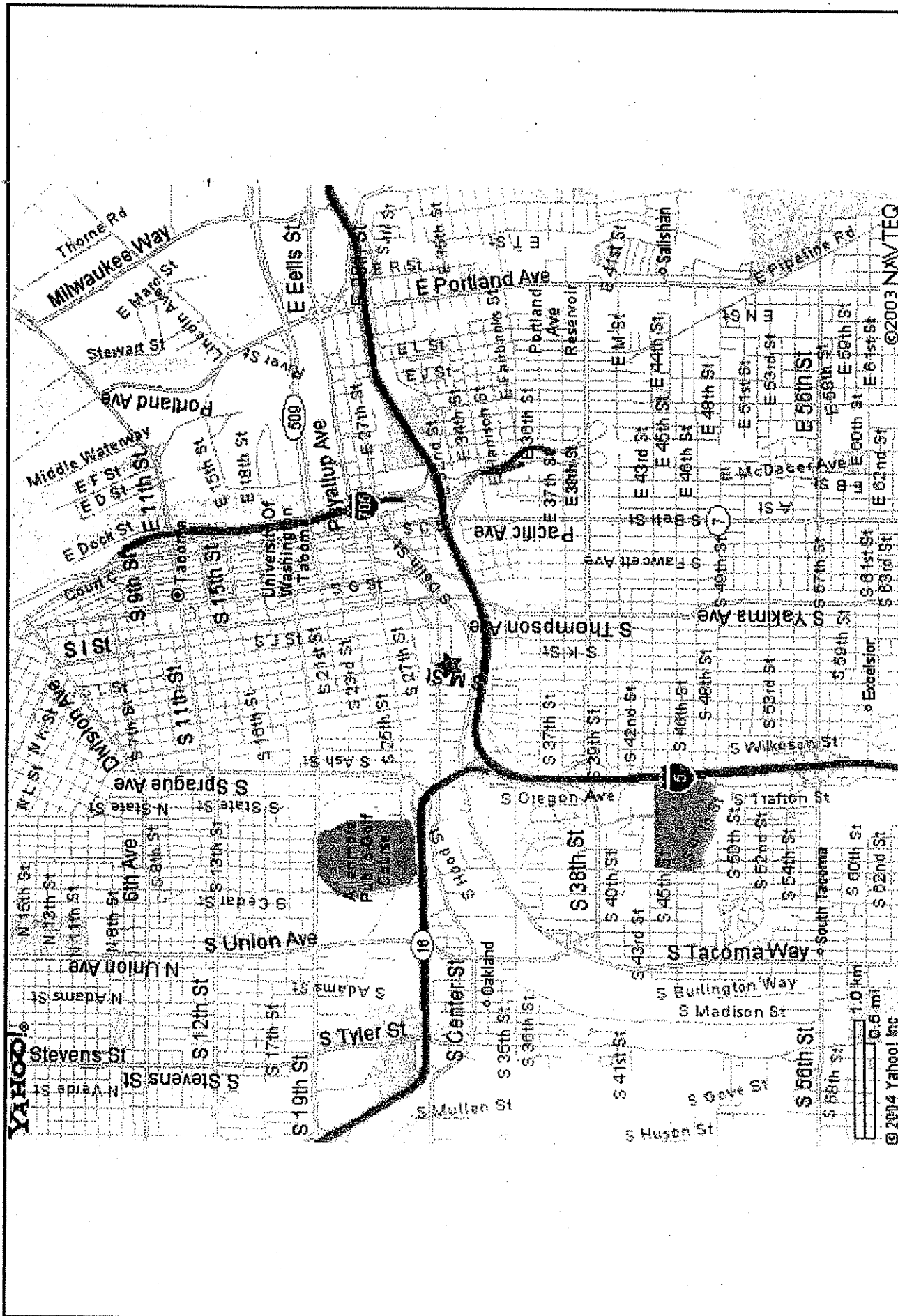
Comparability is an expression of the confidence with which one data set can be compared to another. QA procedures in this document will provide for measurements that are consistent and representative of the media and conditions measured. All sampling procedures and analytical methods will be consistent to provide comparability of results for samples and split samples. Data collected under this QAPP also will be calculated, qualified, and reported in units specified by the quantitation limits as listed in Table 6.1. These units have been selected to provide for comparability of the data with previously generated relevant site data and pertinent criteria.

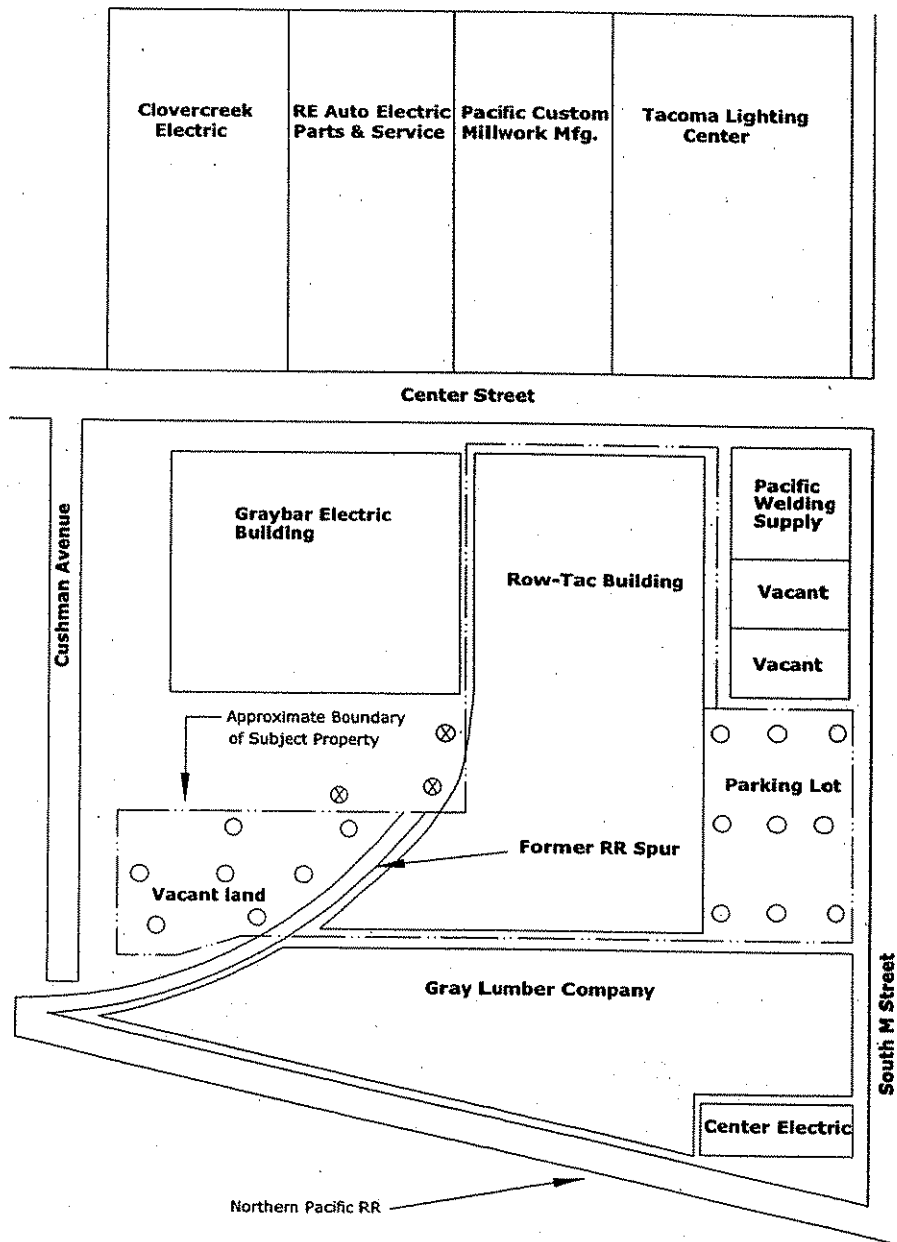
Quantitation Limits

The quantitation limits (reporting limits) for each chemical analysis in Table 4 are targeted to be less than MTCA CULs. Target reporting limits, as listed in Table 4 are the lowest possible reporting limits for each method as performed by the laboratory. The reporting limits listed are goals only, since high sample concentrations, non-homogeneity of samples, or matrix interferences may occur which preclude achieving the desired reporting limit and associated QC criteria. In such instances, the laboratory will report the reasons for deviations from these quantitation limits.

5.0 References

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- Saltbush Environmental Services Inc. 2002. Limited Phase II Site Investigation, The Camas Property Project, 2926 South M Street, Tacoma, Pierce County, Washington, 98409. Prepared for Camas Associates. May 23.
- United States Department of Transportation (USDOT). 2002a. Code of Federal Regulations, Title 49 – Transportation, Sec. 173.6 Materials of trade exceptions. 49CFR173.6. US Government Printing Office via GPO Access. October 1.
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- United States Environmental Protection Agency (USEPA). 1998. *EPA Guidance Document for Quality Assurance Project Plans*. Publication EPA QA/G-5, EPA/600/R-98/018.
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- Washington State Department of Ecology (Ecology). 2001. Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies. Publication No. 01-03-003. February.
- _____. 2001a. Chapter 173-340 WAC, Model Toxics Control Act (MTCA) Cleanup Regulation. February.



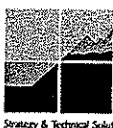


Notes:

1. ○ Proposed geoprobe locations
2. ⊗ Proposed geoprobe location dependent upon offsite access restrictions

Not to Scale

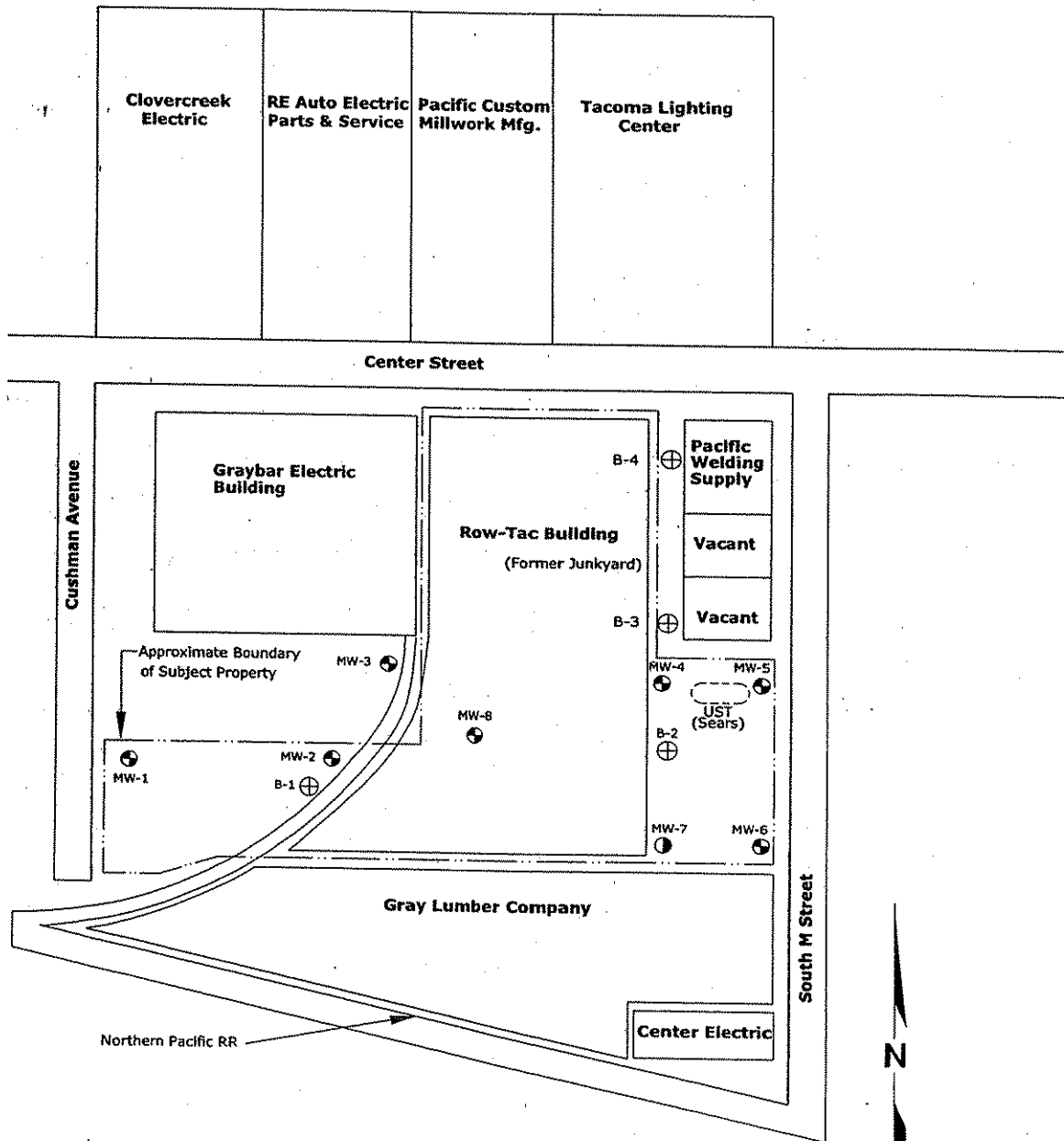
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**Floyd
Snider
McCarthy, Inc.**
 Strategy & Technical Solutions for Contaminated Properties

Camas Property
Tacoma, WA

Figure 2
Proposed Boring Locations



Notes:

1. Proposed Groundwater Monitoring Well Location
2. Former Soil Boring Location
3. Existing Groundwater Monitoring Well

Not to Scale

DATE: 04/22/04 11:37am
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Camas Property
 Tacoma, WA

Figure 3
 Existing and Proposed
 Well Locations